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Title: ALPINE Overview

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Intended for: General ALPINE-related slides for release to the Exascale Computing Project

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# ALPINE Overview

Approved for public release



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Los Alamos National Laboratory

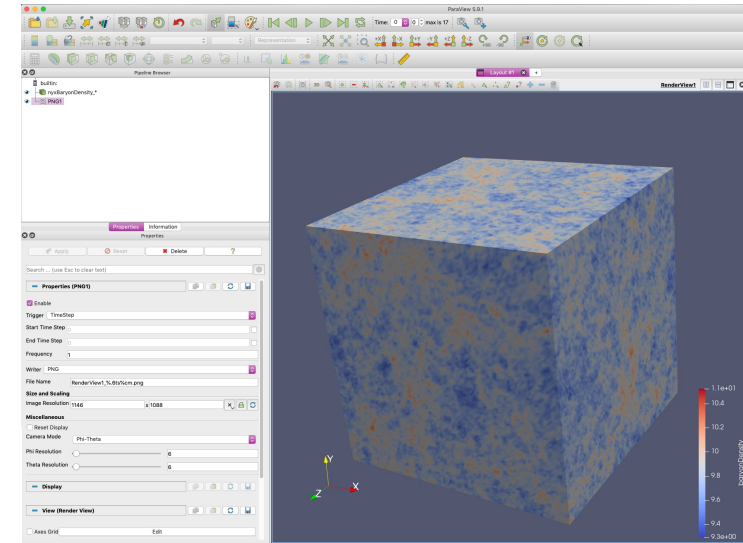
General ALPINE slides for release to Exascale Computing Project

# ALPINE Infrastructure

ParaView/Catalyst

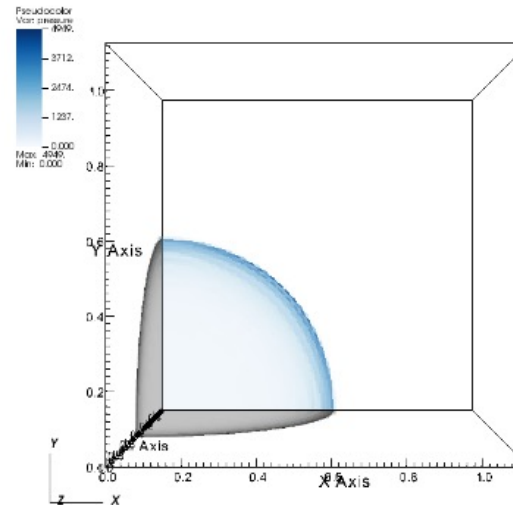
<https://www.paraview.org>

A Nyx Cosmology data set in ParaView.  
Image courtesy of ALPINE LANL team.



Visit

<https://visit-dav.github.io/visit-website/>



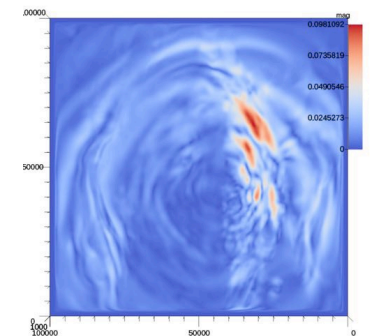
The Sedov blast wave data set in VisIt.  
Image courtesy of ALPINE LANL team.  
[https://codesign.llnl.gov/lulesh/LULESH\\_OMP.cc](https://codesign.llnl.gov/lulesh/LULESH_OMP.cc)

Ascent

<https://github.com/Alpine-DAV/ascent>



Examples of the SW4 earthquake simulation integrated into ALPINE's Ascent infrastructure.  
Right: the displacement magnitude in a shock wave. Left: using a VTK-m renderer to visualize the SW4 simulation.  
Images courtesy of ALPINE LLNL team.

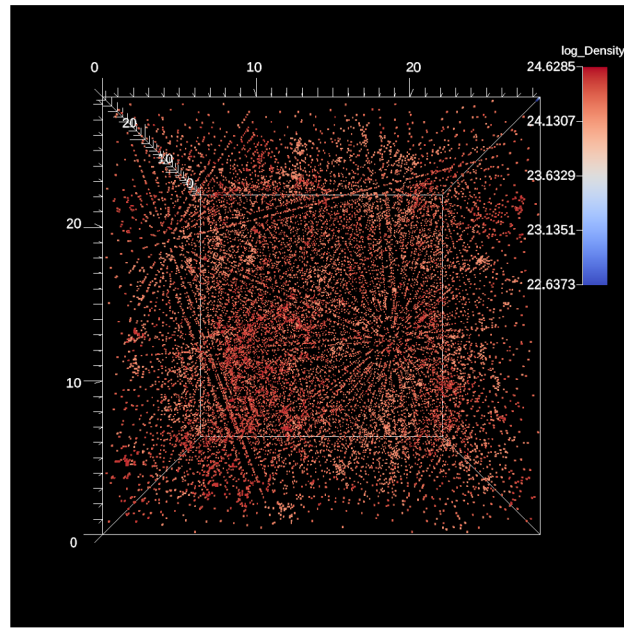




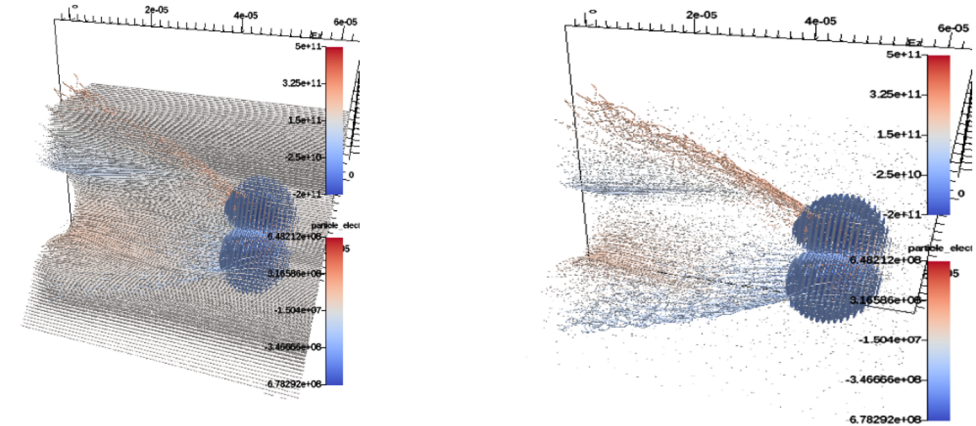
# Sampling Algorithm Integrated into Ascent & ECP Applications

## Goal: In situ data reduction

**Data-driven sampling** enables probabilistic identification of interesting regions in the data automatically, prioritizing important regions. Applied in situ to Nyx, important halo regions are preserved.



## Future: Adaptive Sampling



More features: light/shadow maps, box transformations, phase space, ...



ALPINE Algorithms: Adaptive Sampling

<https://alpine-day.readthedocs.io/en/latest/sampling.html>

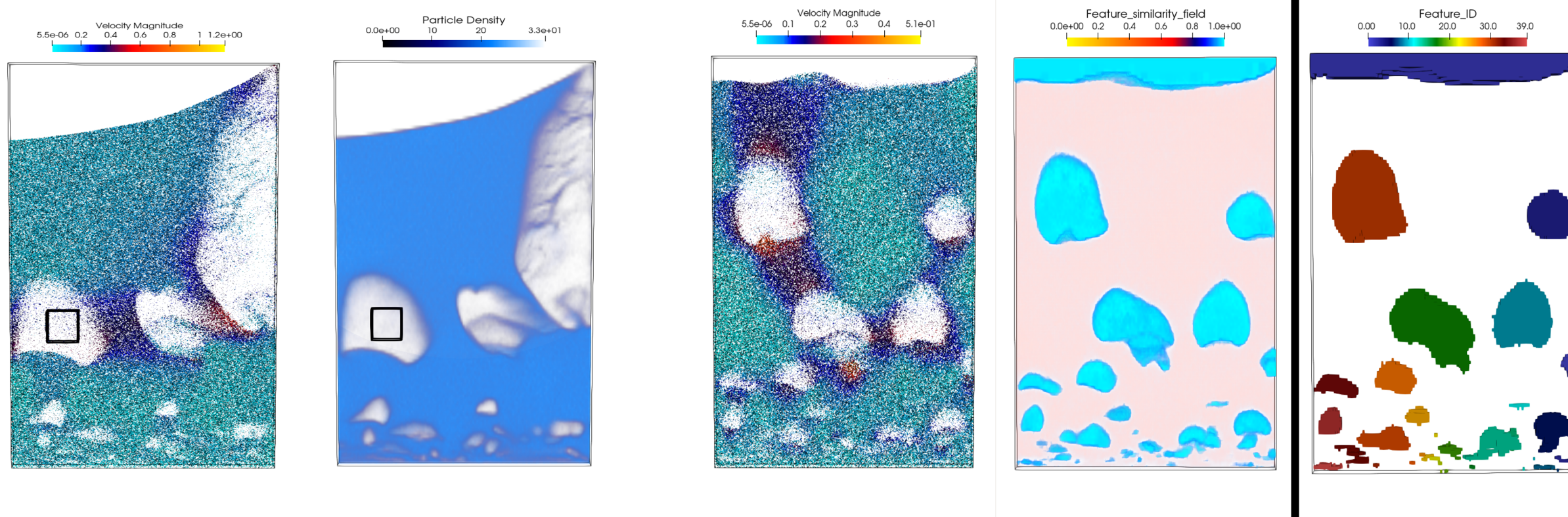
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WarpX applies in situ sampling to transverse momentum to preferentially select particles behaving unexpectedly.

Image curtesy of A. Huebl (WarpX)

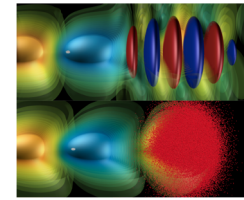
# Statistical Feature Detection integrated into Catalyst &

In situ **statistical feature detection** detects features in particle data sets using statistical data modeling and probabilistic similarity measures.

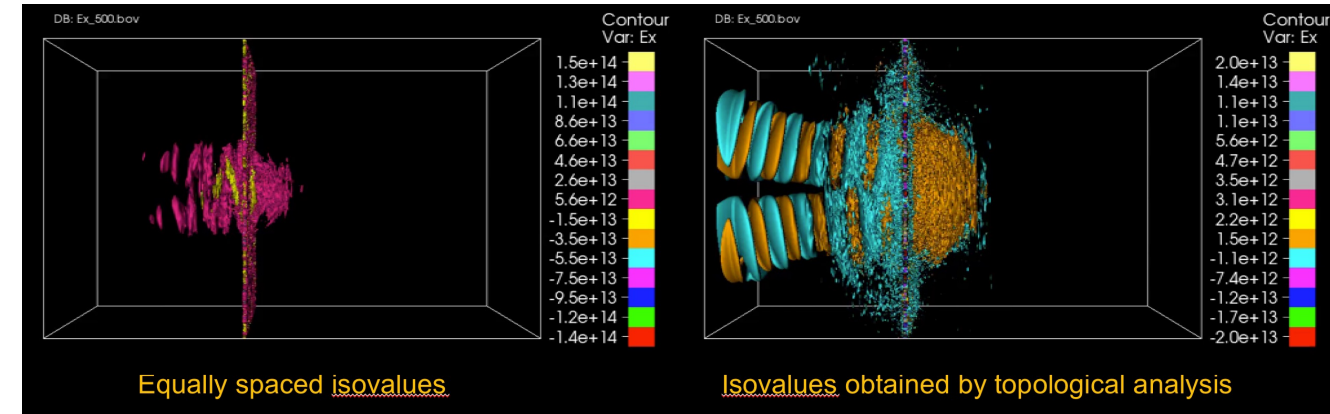
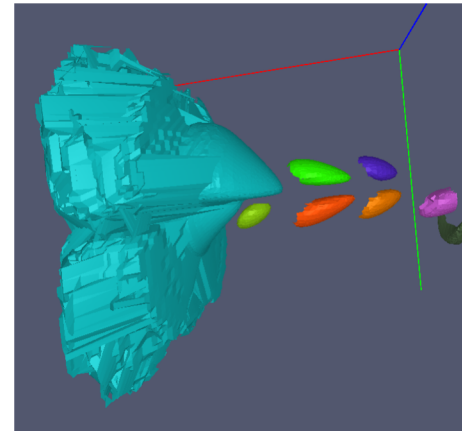
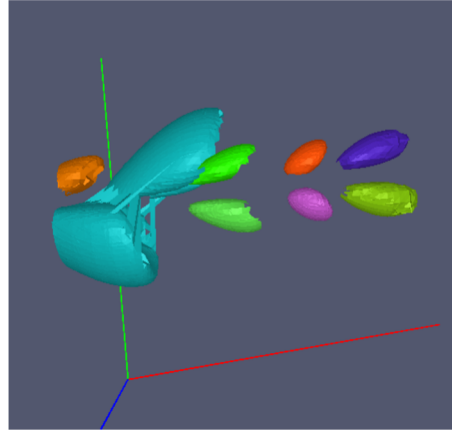


**Goal:** in situ data reduction & feature detection with post hoc interactive analysis via Cinema

# Contour tree integration with WarpX



**Topological analysis** is used to identify most relevant contours & create isosurface visualizations in situ; saving resulting images for post hoc analysis. Images are saved to a Cinema DB in a format that supports arbitrary combination of contours during post hoc visualization. Right: Most relevant contours in WarpX simulation selected using two importance measures: persistence, volume.



**Topological analysis** can be used to detect the most significant isosurfaces in complex simulations. At left, equally spaced isovalues in an ion accelerator simulation. Above, our method chooses isovalues using topological analysis to more fully represent complex behavior in the data.